

# Mission Effectiveness of C4ISR Systems in Network Integration Evaluations

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# Operational Testing

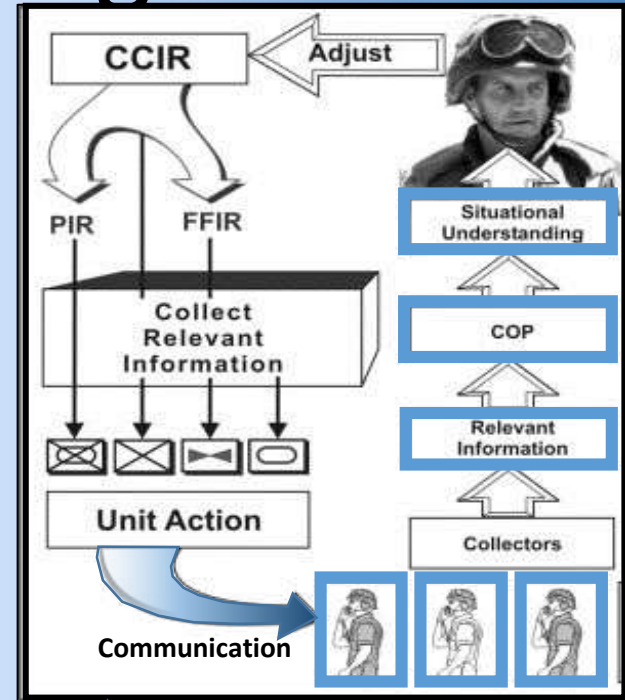
## Measures of Performance

Message Completion Rate

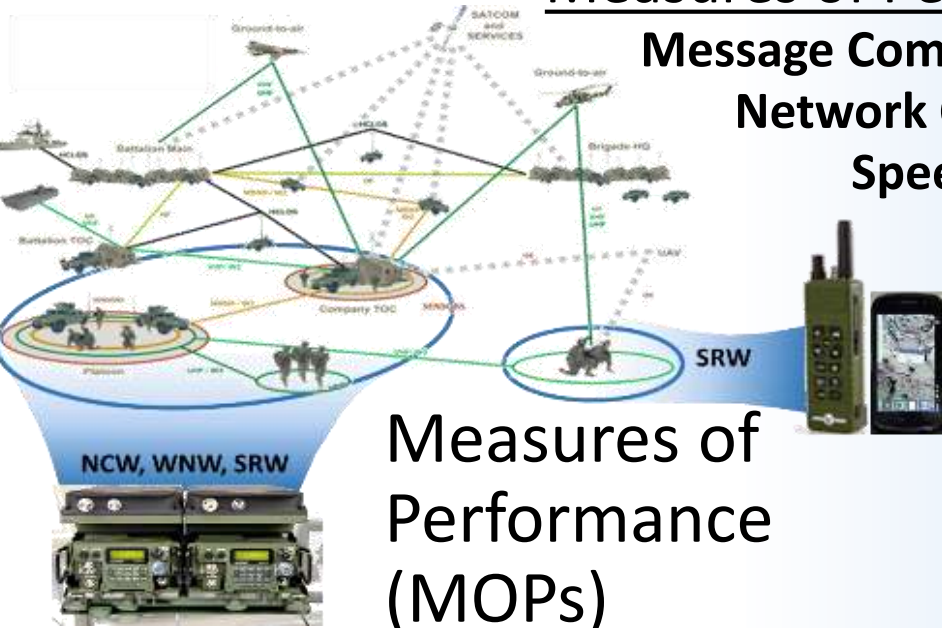
Network Connectivity

Speed of Service

Throughput



Measures of Performance (MOPs)



Developmental Performance

Operational Effectiveness

Measures of Effectiveness (MOEs)



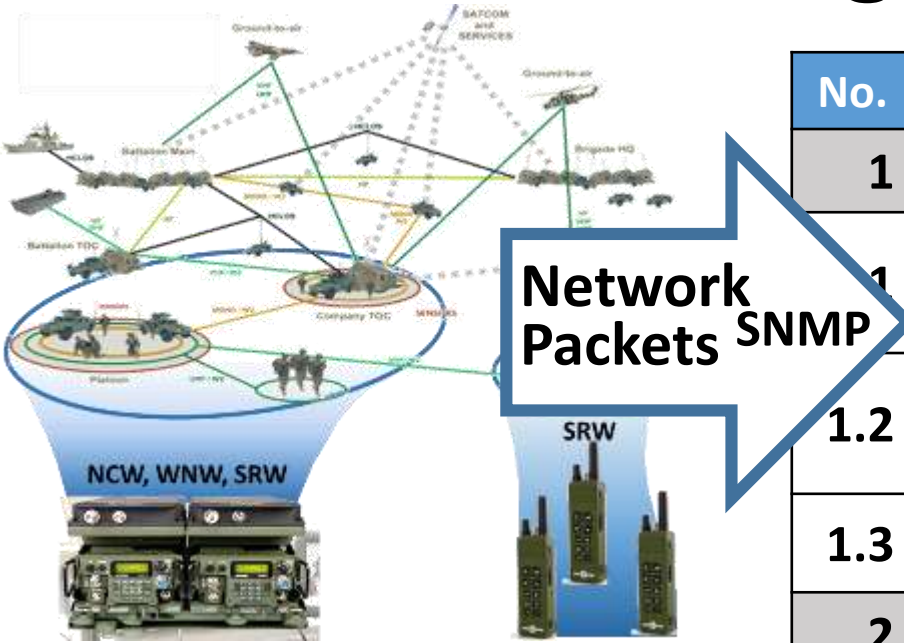
Does the system work as specified?



Does it work as intended for the Warfighter?

# Current Paradigm in OT: Systems

Notional Example



Instrumented Data

No.	Typical Dendritic	Threshold
1	Measure of Effectiveness 1	Not Specified
1.1	MOP: LOS operating range capability	# km (SRW)
		# km (WNW)
1.2	MOP: Number of Nodes	Up to # (SRW)
		Up to # (WNW)
1.3	MOP: Connection Availability	# %
2	Measure of Effectiveness 2	Not Specified
2.1	MOP: Delivery Reliability (MCR)	# %



Surveys and Interviews

No	Typical Question	Scale
1	How well do you feel the data message capability supported your mission accomplishment?	Likert
3	How well do you feel the voice message capability supported your mission accomplishment?	Likert
	Did having multiple presets improve your ability to communicate (over the radio you use most often now)?	Interview

Manual Data

# Change the Paradigm

**Commander's Intent**

Systems View

**Comparative Analyses**

Satisfaction of Requirements

# Current Design of Experiments

**Uncontrolled Factors  
(e.g. Combat, Weather)**

**System  
Factors:**

Terrain  
Transport protocol  
Movement  
**Operational Constraints**  
**Mission**



**Response  
Variables:**

**Measures of  
Performance**

**System-centric**

# Reconsidering the Paradigm: Unit's View

**Uncontrolled Factors  
(e.g. Combat, Weather)**

**System  
Factors:**

System MOPs

**Operational Constraints**

**Mission**



**Response  
Variables:**

**Measures of  
Effectiveness**

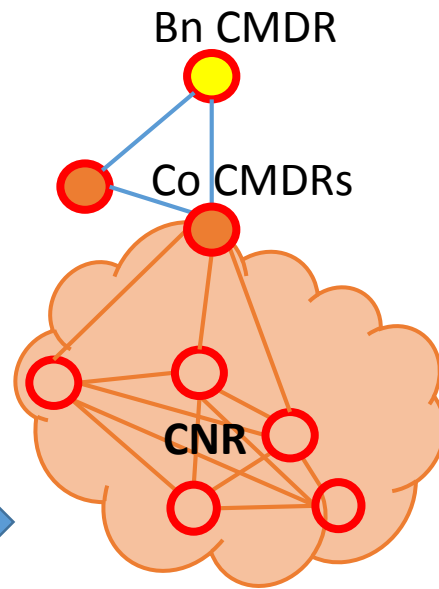
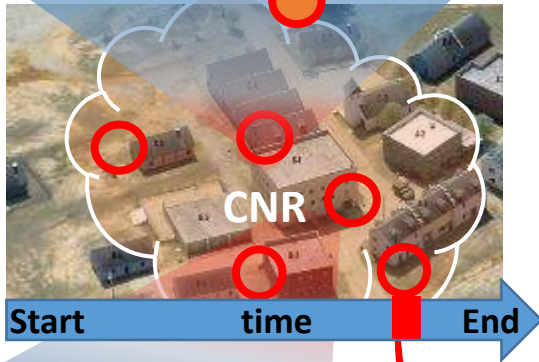
**Unit-centric  
(Commander's Intent)**

# Cordon & Search: Clearing Buildings

What really matters to a commander when he has to clear a set of buildings?

- Message Completion Rate? Or maybe ...
- Time to clear the buildings
- Throughput?
- Casualty rate

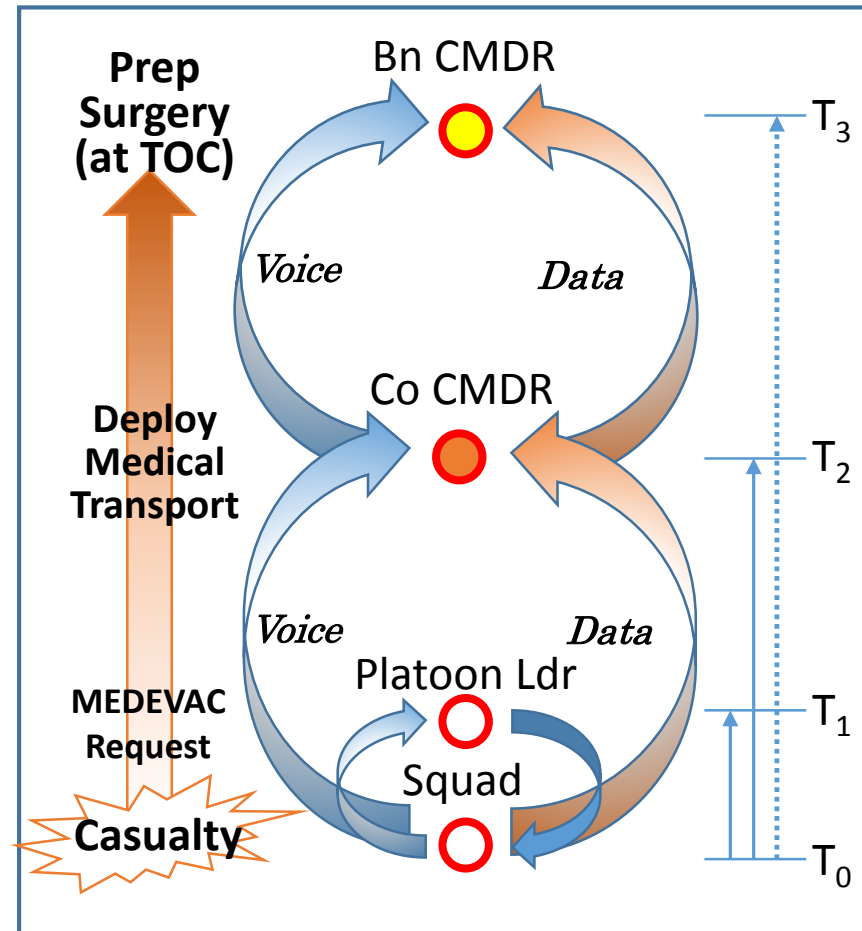
Case 1: Communicate with the Commander



MEDEVAC Request



Case 2: MEDEVAC – Call Availability



# SME Definition of Operational Criteria

## Notional SME's Responses to Cordon and Search

Critical Task / Activity (ranked by importance)	Waveform Voice Call Attributes (MOE)		Radio Factors to Attributes
	Voice Call Duration (sec)	% Availability	
<b>MEDEVAC Request</b> (reading the 9-line card)	<b>20 - 90</b>	<b>100</b>	Range, Terrain, Co-site Interference
<b>Communicate with the Commander</b>	<b>2-10</b>	<b>75</b>	Range, Terrain, Co-site Interference
<b>Check Point Verify</b>	<b>4 - 10</b>	<b>50</b>	Range, Terrain, Movement, Co-site Interference
<b>Supply Needs</b>	<b>5 - 10</b>	<b>50</b>	Range, Terrain
<b>Call Fires/Air Strike</b>	<b>5 - 30</b>	<b>90</b>	Range, Terrain



# Comparative Analysis



# Comparative Analysis Example

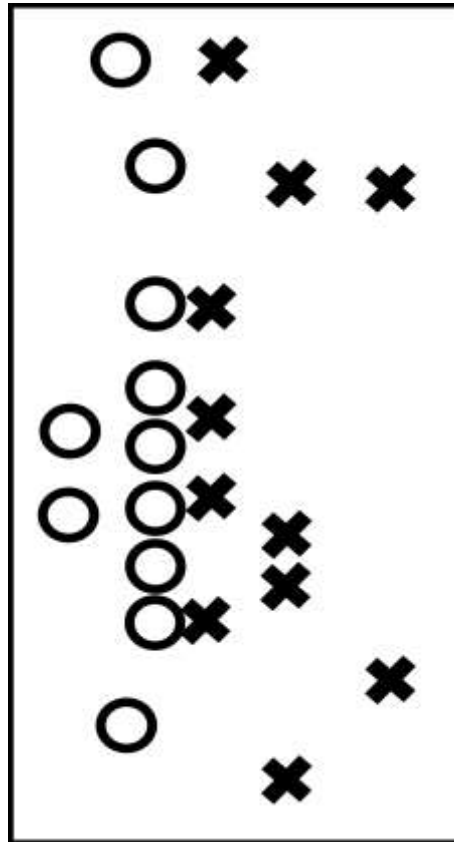
## Cordon and Search Results (*notional values*)

Radio Measures of Effectiveness	Waveform A	Waveform B
% Coverage of Area of Operation (%CAO)	45	87
% Call Availability	64	75
Call Quality (Likert)	4.5	3.6
End-to-End time for SPOT Report (voice)	14 sec.	14 sec.
End-to-End time for SPOT Report (data)	34 sec	n/a

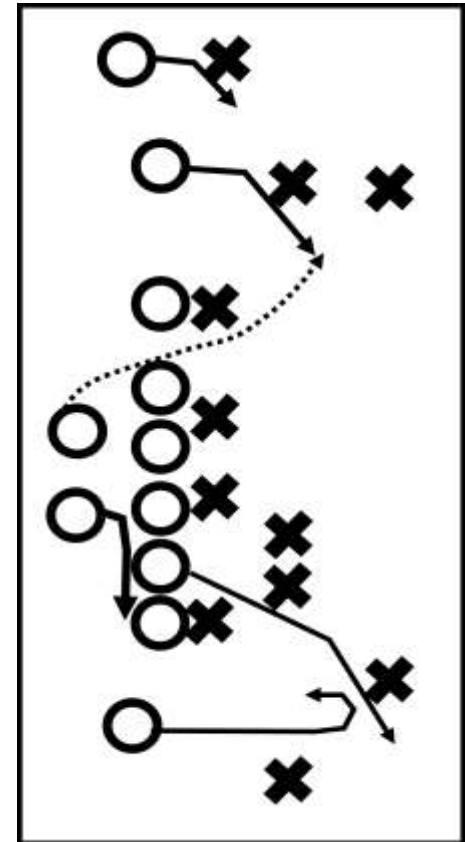
# Comparative Analysis of Systems

*QB swing right.  
Left wide receiver  
and left tail-back  
step up the line  
of scrimmage  
and angle right  
blocking your  
defensive cover;  
fullback angles to  
the left wide  
receiver...*

**Voice only**



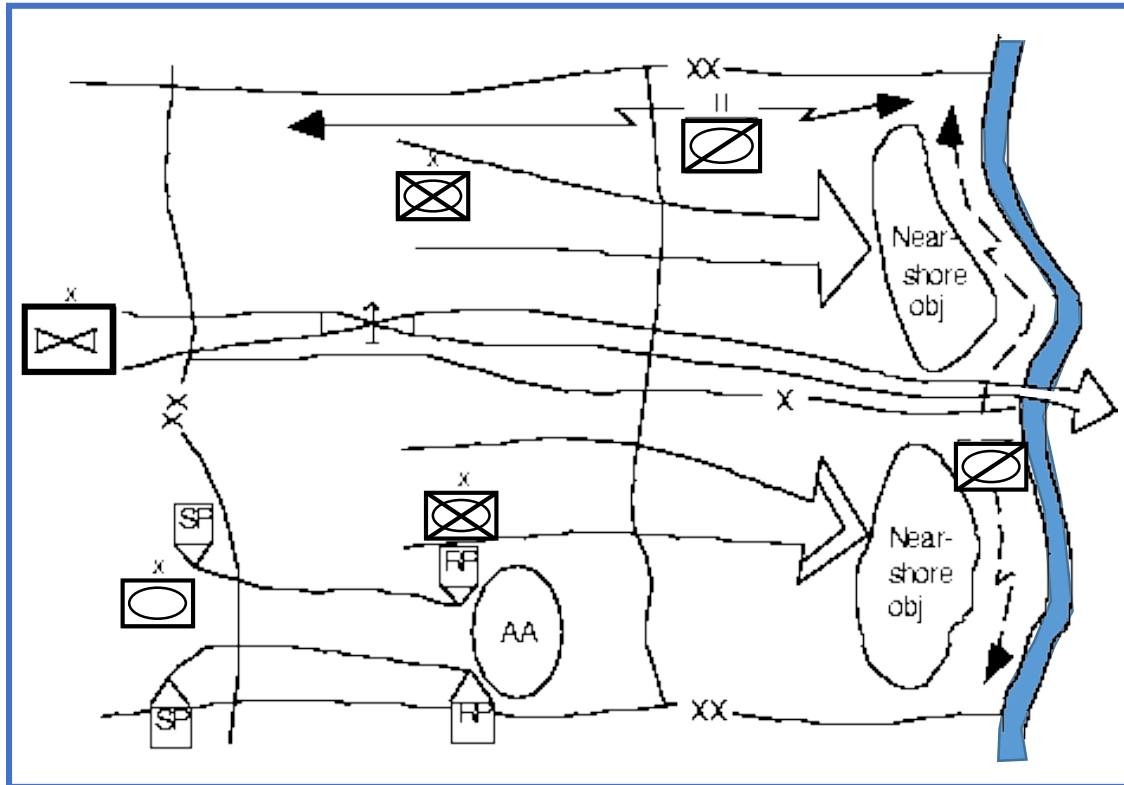
**Position Location +  
Voice**



**Whiteboard +  
VOIP**

Which provides the fastest, most accurate SA?  
Voice only, JBC-P or CPOF?

# Executing a River Crossing



What really matters to a commander when he has to cross a river?

- Message Completion Rate?
- Data Throughput?

Or maybe ...

- Ensure consistent information across all the units
- Use battle command software to improve speed of maneuver
- Ensure communication security

# Conclusions

- Commander's Intent: The key to improving the evaluation of operational effectiveness is to include metrics that characterize the Soldier or unit's use of the system.
- Comparative Analyses: Once the operational metrics for the unit have been measured, the metrics in question must be evaluated against a reference scale, ideally a reference unit executing the same missions in the same environment.
- The next step is to identify two case studies, one communication, one battle command system to optimize a DOE.